Comparison of Atmospheric Angular Momentum in Simulations Produced by the Atmospheric Model Intercomparison Project (AMIP)

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The total angular momentum of the global atmosphere (AAM) about the rotation axis represents a fundamental measure of its dynamical state. Examination of the time-varying AAM produced by the general circulation models participating in AMIP, therefore, provides a useful benchmark for evaluating the response of the various models to the prescribed forcing over a wide range of time scales. In this report, we examine AAM fluctuations due to zonal winds produced by nine 'models for the decade 1979-1988. Observed AAM fluctuations for this period were calculated from zonal winds produced operationally by the National Meteorological Center up to the 50 mb level. An independent verification data set is obtained from fluctuations in the length-of-day (LOD), measured by space geodetic techniques. After removal of a quadratic term to account for core-mantle coupling, the LOD time series serves as a useful proxy for global AAM.

The excess angular momentum due to the atmosphere's super-rotation with respect to the Earth represents an LOD increase of about 2.5 msec. Although all of the models exclude some portion of the upper atmosphere (ranging from about 1 to 10% of the total mass), most of them produce an average super-rotation of about the right magnitude. The AMIP decade was characterized by two well-defined ENSO events (1982-83 and 1986-87), both of which left clear signatures in the verifying LOD and AAM data sets. Most of the models showed comparable signatures in their simulated AAM variations, with the exception of two models which failed to produce reasonable values of the average AAM. On seasonal time scales, the rms variability of the model AAM ranges from about 60% to 150% of that for the verification data sets. Further studies to localize the discrepancies found in the global AAM data are underway.

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